

CLAIMS

1. An interventional procedure simulation system, comprising a control unit and an interface unit, said control unit communicating with said interface unit to simulate
5 handling of a number of simulated nested instruments simultaneously interfaced by said interface unit and, said instruments being arranged to move and rotated independently of each other and said movements and rotations being propagated to the other instruments, said control unit further comprising an instruction set comprising:
 - 10 ▪ a first instruction set for handling and processing input from said user,
 - based on said input, generating a second instruction set for controlling said interface,
 - a first data set comprising characteristics for said instruments,
 - a second data set comprising data on a body part to be simulated, and
15 ▪ a third instruction set for generating control signals relating to an interaction between said simulated instruments and a surrounding geometry relating to a part of said simulated body part.
2. The system of claim 1, wherein said interventional procedure is at least one of a
20 diagnostic, a cardiovascular or endovascular simulation system.
3. The system of one of claims 1 - 2, wherein a user's movements of said instruments, a surrounding simulated anatomy and other present instruments, affect a shape of an instrument simulated and displayed.
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4. The system of claim 3, wherein for each instrument collisions with simulated surrounding calculations are executed by said control unit, which affects the shape and position of said instrument in said simulated body part.
- 30 5. The system of any of preceding claims, wherein an instrument is a distal part of a tool, or unique features at the distal end of a tool.
6. The system of any of preceding claims, wherein different instrument types can be used comprising balloons, stents, electrodes, wires, catheters, distal protection, etc.
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7. The system of claim 6, wherein each instrument type has different properties associated to it and provided as an instruction set, which describes substantially all properties of said instrument.

5 8. The system of claim 6, wherein the properties of said instruments further describe interaction with surrounding geometry, visual properties, stiffness, shape etc.

9. The system of claim 8, wherein simulated properties of said instrument are altered in real-time.

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10. The system of any of preceding claims, wherein the system comprises a model (210) used for rendering objects depending on properties to be displayed and a collision model (220) for computing collisions between the simulated instrument and body part.

15 11. The system of any of preceding claims, wherein a model of said body or part of said body part is a three-dimensional data obtained through a body scanning.

12. The system of claim 3, wherein said instrument movements and rotations interact simulated with other instruments.

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13. A method for simulating an interventional procedure, comprising the steps of:

- providing a control unit and an interface unit, said control unit communicating with said interface unit to simulate handling of a number of nested instruments simultaneously interfaced by said interface unit and that each nested tool can be moved and rotated independently of the other and said movements and rotations are propagated to other instruments,
- providing a first instruction set for handling and processing input from said user,
- generating a second instruction set based on said input, for controlling said interface,
- retrieving information on said instrument comprising a first data set comprising characteristics for said instruments,
- providing a second data set comprising data on a body part to be simulated, and
- generating control signals relating to interaction between said instrument and a surrounding geometry by a third instruction set.

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14. The method of claim 13, changing instrument simulated and displayed based on a user's movements of said instruments, a surrounding simulated anatomy and other present instruments, effect a shape of an instrument simulated and displayed.

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15. The method of any one of claims 13-14, wherein an instrument is a distal part of a tool, or unique features at the distal end of a tool.

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16. The method of any one of claims 13-15, wherein different instrument types can be used comprising balloons, stents, electrodes, wires, catheters, distal protection, etc.

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17. The method of claim 16, wherein each instrument type has different properties associated to it and provided as an instruction set, which describes substantially all properties of said instrument.

18. The method of claim 16, wherein the properties of said instruments further describe interaction with surrounding geometry, visual properties, stiffness, shape etc.

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19. The method of claim 16, wherein simulated properties of said instrument ~~may be~~ are altered in real-time.

20. A system for an interventional procedure simulation, said system comprising a control unit and an interface unit, the system further comprising:

- 25 ▪ means for communication between said control unit and said interface unit
- means in said interface unit to simulate handling of a number of nested instruments, independently movable and rotatable, simultaneously interfaced by said interface unit,
- interface member for receiving input from said user,
- 30 ▪ means for handling and processing said input,
- means for controlling said interface,
- a first database for storing characteristics for said instruments,
- a second database for storing characteristics about a body part to be simulated, and
- 35 ▪ means for generating control signals relating to an interaction between said simulated instruments and a surrounding geometry relating to a part of said simulated body part.

21. The system of claim 20 wherein said characteristics about a body part to be simulated are obtained through a scanning process.

5 22. A computer program for interventional procedure simulation in a system comprising a control unit and an interface unit, said program comprising:

- a communication instruction set for communication between said control unit and said interface unit,
- a first instruction set for simulating handling of a number of simulated nested instruments, independently movable and rotatable, simultaneously interfaced by said interface unit, said control unit further comprising an instruction set, comprising:
 - a second instruction set for handling and processing input from said user,
 - a third instruction set for controlling said interface,
 - a first data set comprising characteristics for said instruments,
 - a second data set comprising data on a body part to be simulated,
 - a fourth instruction set for generating control signals relating to an interaction between said simulated nested instruments and a surrounding geometry relating to a part of said simulated body part, and
- a fifth instruction set for outputting simulation on a visualisation member.

23. A program storage device readable by a machine and encoding a program of instructions for executing the computer program for interventional procedure simulation according to claim 23.

24. A computer readable medium having computer readable program code embodied therein to enable an interventional procedure simulation in a system comprising a control unit and an interface unit, said program comprising:

- a communication instruction set for communication between said control unit and said interface unit,
- a first instruction set for simulating handling of a number of simulated nested instruments, independently movable and rotatable, simultaneously interfaced by said interface unit, said control unit further comprising an instruction set, comprising:
 - a second instruction set for handling and processing input from said user,
 - a third instruction set for controlling said interface,

- a first data set comprising characteristics for said instruments,
- a second data set comprising data on a body part to be simulated,
- a fourth instruction set for generating control signals relating to an interaction between said simulated nested instruments and a surrounding geometry relating to a part of said simulated body part, and
- a fifth instruction set for outputting simulation on a visualisation member.

25. A propagated signal for comprising a digitalized program code embodied therein to enable an interventional procedure simulation in a system comprising a control unit and an interface unit, said program comprising:

- a digitalized communication instruction set for communication between said control unit and said interface unit,
- a digitalized first instruction set for simulating handling of a number of simulated nested instruments, independently movable and rotatable, simultaneously interfaced by said interface unit, said control unit further comprising an instruction set, comprising:
 - a digitalized second instruction set for handling and processing input from said user,
 - a digitalized third instruction set for controlling said interface,
 - a digitalized first access code for accessing a first data set comprising characteristics for said instruments,
 - a digitalized second access code for accessing a second data set comprising data on a body part to be simulated,
 - a digitalized fourth instruction set for generating control signals relating to an interaction between said simulated nested instruments and a surrounding geometry relating to a part of said simulated body part, and
 - a digitalized fifth instruction set for outputting simulation on a visualisation member.

26. A system for an interventional procedure simulation, said system comprising a control unit and an interface unit, the system further comprising:

- means for communication between said control unit and said interface unit for receiving at least one instrument used in said interventional procedure,
- means for receiving three-dimensional information on a body part to be simulated, and

- means for generating control signals relating to an interaction between said instruments and a surrounding geometry relating to a part of said simulated body part.

5 27. The system of claim 26, wherein said three-dimensional information is obtained through a scanning process.

28. A system for an interventional procedure simulation learning, said system comprising a control unit and an interface unit, the system further comprising:

- 10 ▪ means for communication between said control unit and said interface unit for receiving at least one instrument used in said interventional procedure,
- means for receiving three-dimensional information on a body part to be simulated,
- 15 ▪ means for generating control signals relating to an interaction between said instruments and a surrounding geometry relating to a part of said simulated body part, and
- means for recording said simulation.

29. A method of an interventional procedure training, using a system comprising a control unit and an interface unit, the method comprising:

- 20 ▪ using an interventional procedure tool to be simulated in said interface device,
- simulating an interaction between said nested instruments, independently movable and rotatable, and a surrounding geometry relating to a part of said simulated body part, and
- 25 ▪ using said simulation for training said user.

30. A method of facilitating an interventional procedure training, using a system comprising a control unit and an interface unit, the method comprising:

- 30 ▪ using an interventional procedure tool to be simulated in said interface device,
- simulating an interaction between said nested instruments, independently movable and rotatable, and a surrounding geometry relating to a part of said simulated body part, and
- using said simulation for training said user.